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구조 진동론 HW #1.

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1. $f_s = k_e u$

$$= k_1 u + k_2 u.$$

$$\therefore f_o = k_1 + k_2 \quad \text{로 예상} : m\ddot{u} + (k_1 + k_2)u = p(t).$$

2. $f_s = k_e u \quad , \quad u = u_1 + u_2$

$$f_s = k_e u = k_1 u_1 + k_2 u_2$$

$$\therefore \frac{f_s}{k_e} = \frac{f_s}{k_1} + \frac{f_s}{k_2} \Rightarrow k_e = \frac{k_1 k_2}{k_1 + k_2}$$

$$\text{로 예상} : m\ddot{u} + \frac{k_1 k_2}{k_1 + k_2} u = p(t)$$

3. $f_s = k_e u = (k_1 + k_2)u_1 + k_3 u_2$

$$u = u_1 + u_2$$

$$\frac{f_s}{k_e} = \frac{f_s}{k_1 + k_2} + \frac{f_s}{k_3} \Rightarrow k_e = \frac{(k_1 + k_2)k_3}{k_1 + k_2 + k_3}$$

$$\text{로 예상} : m\ddot{u} + \frac{(k_1 + k_2)k_3}{k_1 + k_2 + k_3} u = p(t).$$

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6. 강체 질량의 질도를 찾는 방법

$$\rho = \frac{m}{V} = \frac{m}{\frac{1}{2} L b t} = \frac{2m}{L b t}$$



$$dV = \frac{1}{2} \pi r^2 dr \cdot t \quad dm = \rho \cdot dV = \frac{2m}{L b t} \cdot \frac{1}{2} \pi r^2 dr \cdot t \\ = \frac{2m}{L b t} \pi r^2 dr$$

$$\sum M_o = dm \cdot r \theta \cdot r + dm \cdot g \cdot r \sin \theta = 0$$

$$= \frac{2m}{L b t} r^3 dr \theta + \frac{2m}{L b t} r^2 dr \cdot g \sin \theta = 0.$$

전체 강체에 대해 합을 하면.

$$\int_0^L \frac{2m}{L b t} r^3 dr \theta + \int_0^L \frac{2m}{L b t} r^2 dr \cdot g \sin \theta = 0.$$

$$\Rightarrow \frac{1}{4} \frac{2m}{L b t} L^4 \cdot \theta + \frac{1}{3} \cdot \frac{2m}{L b t} L^3 g \sin \theta = 0.$$

$$\Rightarrow \frac{m L^2}{2} \theta + \frac{2 m L}{3} g \sin \theta = 0.$$

$$\Rightarrow \theta + \frac{4g}{3L} \sin \theta = 0. \quad - (a)$$

다음 번역 6번에 대해 흑체화하면 $\sin \theta \approx \theta$.

$$\theta + \frac{4g}{3L} \theta = 0. \quad - (b)$$

$$\text{회전동수} \quad w_n = \sqrt{\frac{4g}{3L}} \quad - (c)$$



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8. $-f_z + f_s = 0$

$$f_z = I_0 \cdot \dot{\theta}, \quad f_s = k_s \cdot \theta$$

$$I_0 = \frac{1}{2} m R^2 \quad k_s = \frac{GJ}{L} = \frac{G}{L} \cdot \frac{\pi d^4}{32}$$

$$\therefore \frac{1}{2} m R^2 \dot{\theta} + \frac{G \pi d^4}{32 L} \theta = 0.$$

$$\Rightarrow \ddot{\theta} + \frac{G \cdot \pi d^4}{16 m R^2 L} \theta = 0.$$

↑ ω 의 대수식
계수

12. $f_z + f_s = 0$.

$$f_z = m\ddot{u} \quad f_s = k_e u = k_{beam} \cdot u_{beam} = k_{spring} \cdot u_{spring}$$

$$u = u_{beam} + u_{spring}$$

$$\Rightarrow \frac{f_s}{k_e} = \frac{f_z}{F_{beam}} + \frac{f_z}{k_{spring}}$$

$$\Rightarrow k_e = \frac{k_{beam} \cdot k_{spring}}{k_{beam} + k_{spring}}$$

$$k_{beam} = \frac{w}{u_{beam}} \quad u_{beam} = \frac{wL^3}{f_{z2}} \Rightarrow k_{beam} = \frac{48EI}{L^3}$$

$$\therefore k_e = \frac{48EI/L^3 - k}{48EI/L^3 + k}$$

$$\text{보조 방정식: } m\ddot{u} + k_e u = 0. \quad \text{주방정식: } u_n = \sqrt{\frac{k_e}{m}}$$

ω 의 대수식

$$= \sqrt{\frac{48EI/L^3 - k}{48EI/L^3 + k}} \cdot \sqrt{\frac{m}{m \cdot g}}$$



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19. $f_x + f_s + f_b = 0$. $\ddot{u}^x = u_g(x) + \ddot{u}(x)$
 $= u_g(vt) + u(x)$

$$f_x = m \ddot{u}^x = m(\ddot{u} u_g + \ddot{u})$$

$$f_s = k u$$

$$f_b = c \dot{u}$$

$$\therefore m \ddot{u} + c \dot{u} + k u = -m \ddot{u}_g(x)$$

$$m \ddot{u} + c \dot{u} + k u = -m v^2 \frac{d^2 u_g(x)}{dx^2}$$

$$m \ddot{u} + c \dot{u} + k u = C v \frac{du_g(x)}{dx} + k u_g(x)$$